

whale is the biggest known mammal; our gigantic salamander is the biggest known amphibian; probably our sun-fish, our tunnies, our sharks, and our devil-fish, are each in their way larger than any previous fishes—one living shark actually attaining a length of forty feet. No fossil bivalve molluscs are, to my knowledge, as big as the common Mediterranean pinna, or as that giant clam, the tridacna, whose shell is so commonly used as a basin for fountains. In fact there are only two important groups, the birds and the reptiles, in which extinct species were much larger than existing ones; and in these two groups the decrease is evidently due to the later supremacy of the mammalian type."

He then goes on to show that in many lines of descent we find groups of animals which have steadily been increasing in size from the earliest epoch of their appearance to the present day, as, for example, the horses, the deer, and the elephants. Evolution generally tends towards increase of size in dominant groups; but when a group ceases to be dominant and begins to decay its bigger members die out.

Equally interesting and suggestive are the discussions on colour and the colour-sense, *à propos* of the "Veronica" and the distribution of fishes, in "The carp pond" and "The mountain tarn"; but we pass on to the chapter devoted to "The donkey's ancestors"—a charming sketch suggested by "a dear shaggy old donkey making himself perfectly happy upon a bare rocky hillside, upon four sprouting thistles, a bit of prickly carline, and three square yards of wet turf at the outcrop of a little spring." Let us, however, pass by his pedigree (the same as that of his cousin, the horse), and see what Mr. Allen has to say about his intelligence, and the reason of it.

"Donkeys are the final flower of long ages of native evolution, the natural head and crown of one great line of mammalian development. To doubt their intelligence is to impugn the whole conduct of nature, to upset the entire system of evolutionary psychology off-hand. Donkeys cannot help being clever, because they are the final survivors in the struggle for existence in one of the most specialised, most highly developed, and most dominant mammalian stocks. They do not represent mere stranded and struggling relics of older types, like the very silly kangaroos, and ant-eaters, and hedgehogs, which drag on a miserable existence behind the times in out-of-the-way holes and corners of the earth; they are one of the finest developments of one of the most successful branches of the great ungulate tribe. I feel a genuine respect for every donkey I meet, when I remember that it was the mere accidental possession of an opposable thumb that gave my ancestors a start over his in the race for the inheritance of the earth towards the very close of the tertiary period."

In reading this most entertaining and instructive volume almost every page offers some suggestive remark or apposite illustration of the principle of evolution; and it is very rarely that we meet with anything to which exception can be taken on the score of accuracy. It is perhaps doubtful whether monkeys are "intellectually in the very front rank of the animal world," notwithstanding "the opposable thumb and the highly mobile trunk, with its tactile appendage, give these creatures an exceptional chance of grasping an object all round, and so of learning its physical properties." I am myself inclined to think they are decidedly inferior to dogs, horses, and elephants. So the tracing of man's sense of colour to the fact of our pre-

human ancestors having been attracted by the bright colours of the orange, blue, and crimson fruits of tropical forests appears doubtful, if not erroneous; because the colours of such fruits are no indication of their edibility for either man or monkeys, and there is no reason they should be so, since mammalia in eating the fruits would be likely to crush and destroy the vitality of the seeds. At all events many bright coloured tropical fruits are poisonous, while many that are eatable are green and unattractive. Even among our native berries children who trust to enticing colour are apt to be poisoned by bitter-sweet or deadly nightshade. Neither is there any evidence that—

"Up to the beginning of the tertiary period, large evergreens of what is now the tropical type covered the whole world as far as the very poles themselves. Greenland and Spitzbergen then supported huge forests of the same general character as those which now spread over Brazil and the Malay Archipelago."

Nor is Buffon's idea—that organic life must have begun at the Poles, because on the surface of an incandescent planet the poles would be the first part to cool down sufficiently to allow of the conditions under which alone life becomes possible—at all in accordance with the teachings of modern science, as Mr. Allen maintains it to be. For the first cooling of the surface would necessarily occur at a time when the whole of the water of the globe was in a state of vapour, and this vast aqueous atmosphere would so far prevent the heat of the sun from reaching the surface, and so equalise radiation that there need have been no cooling at the poles earlier than at the equator; and when subsequently the water was condensed and oceans were formed, these would equalise temperature over the whole surface, and render it possible for life to originate at one part as well as at another. But these are very slight blemishes in so excellent a book, which is calculated to bring home to every reader how much of interest and novelty, of intricacy, of beauty, and of wonder, is to be found in the structure or history of the humblest plants or the most familiar animals; and also, how greatly the once-decried doctrine of evolution has added to the ideal and poetic aspects of the study of nature.

ALFRED R. WALLACE

THE COMPASS

Traité Théorique et Pratique de la Régulation et de la Compensation des Compas. Par A. Collet, Lieutenant de Vaisseau, Répétiteur à l'École Polytechnique. Ouvrage publié avec l'Autorisation de M. le Ministre de la Marine. (Paris: Challamel Aîné, 1882.)

THIS new treatise on the compass contains an admirable account of the most recent work done on the subject, and a very full and practical explanation of the objects of compass compensation and the methods adopted to secure it. It is founded on the author's translation, now twelve years old, of Smith and Evans' Admiralty Manual—made for the benefit of the French marine. That epoch-making book is however still the basis or substratum of Lieut. Collet's new work.

The practical part of the English book is fully given. M. Collet has added as much elementary mathematics and physics as he thinks may be useful to such seamen

who wish to understand the whole subject from his volume, without reference to auxiliary text-books. To a slight extent he has revised the demonstrations and modified the diagrams of the Admiralty Manual—abridging these demonstrations so far as he thinks it possible to do so. He preserves Smith's notation as generally familiar. The newest part of the book is that in which he gives us the full details of the recent methods by which the amount of compensation can be determined with or without altitudes. In the account of these methods his readers will find collected much that it would be impossible for them to find in any English volume, and the exposition has all the merits of the French school. Smith and Evans showed us in their Manual how to determine the five essential coefficients upon which the deviation, when it is less than 20° in absolute value, depends at any position on the earth's surface, and for any course of the ship, three of these being constant. Two observations of the variation at any place accordingly suffice to determine the values of the deviation. Collet points out the necessity of *compensation*, that is to say, of the reduction of the five constants to insignificant values which can be determined even in a fog, when no observations of altitude can be taken, a method, of course, of the highest importance to practical men in circumstances of actual difficulty, which are constantly recurring. The theoretical part of the Admiralty Manual is given as succinctly as it is perhaps possible to give it if it is to be clearly mastered; the practical part is dwelt upon in full detail, and the rules are so simple and plain that ordinary captains in the merchant service ought to be able to use them accurately, even if they are unable to master the scientific part.

There is an excellent account of Sir William Thomson's compass. The fundamental ideas on which that instrument is constructed are that the magnetised needles must be so small that we may safely neglect their length, and that the intensity of their magnetism must be so slight that there is no reciprocal action between them and the soft iron correctors. The compass card is extremely light. A card of 10 inches diameter is directed by eight small needles, four on each side, like ordinary sewing-needles, of from 2 to 3 inches in length, and weighing in all about $3\frac{1}{2}$ grammes. These are hung by two parallel silk threads, and attached to the card by silk threads passing through the two eyes at the two ends of each needle. The entire weight of the card, the needles, the outer circle of aluminium, the silk threads, the cap which rests on the vertical point, &c., is only 12 grammes, which is about 1-10th of what it is in the ordinary compass. This, of course, gives much less friction than usual between the point and the cap, so that the error due to friction is reduced in practice within a range of a quarter of a degree.

The feeble magnetic moment of the system involves two important consequences—the period of oscillation round the position of equilibrium is only about 40 seconds, whereas it is three times as much in an ordinary compass card, and the suspension by silk threads makes the whole card so elastic that it is much less liable to be prejudicially affected by any sudden shock, such, for instance, as the firing of a cannon on board.

M. Collet gives an account of the compensated compasses of Peichl, a lieutenant in the Austrian naval

service. Peichl aims, like Sir William Thomson, to reduce the five coefficients used in determining the deviation to insignificant values. We must refer the reader to Mr. Collet's book to show wherein Peichl differs from Sir William Thomson's system, and wherein M. Collet considers it to be markedly inferior to it in practical value.

The fifth part of the treatise discusses the methods by which it is possible, by the use of Sir William Thomson's deflector, to compensate and to obtain the necessary corrections for the compass in foggy weather, when no observations of altitude, celestial or terrestrial, are possible. These methods are admirable, and even on an iron vessel the most improved modern compass can be trusted by the mariner almost as completely as the chronometer itself. Just as in the case of the chronometer, however, it would be foolish to neglect the opportunities of verification of the instrument which are constantly recurring on shipboard. Continually tested, and its performances brought frequently under review, it serves all the purposes of the seaman, and in foggy as well as in clear weather a captain can trust his compensated compass to navigate his ship.

The brief historical exposition of the development of the compass, which occupies forty pages, is singularly interesting. Founded as it is on the Admiralty Manual, it is reasonable to expect to find, as we do, that the immense work of English men of science should be justly appreciated, but it is not perhaps so much a matter of course that that appreciation should be as generous as it is just. The French scientific man cannot always realise that science may sometimes emanate from other centres than Paris. M. Collet is not less scrupulously just to people of other nations than a German *savant* would be, he is more generous, and his book is more readable.

OUR BOOK SHELF

Stanford's London Atlas of Universal Geography. Quarto Edition. (London: Stanford, 1882.)

THIS new atlas appears to us to be superior in many respects to the ordinary run of such works. There are forty-four maps, and the selection has been made with great judiciousness, and with a special view to adapt the atlas to an English public. Britain and her dependencies occupy a prominent position; Canada has three maps; besides Australia there is a beautiful map of Tasmania, another of New Zealand, and one of the Fiji Islands, a specially original feature. Ceylon, moreover, has a map all to itself. The two maps devoted to Turkestan are of obvious utility, and have evidently been done with great care. There is a specially good separate map of Switzerland. Of Britain, besides the general maps of each of the three kingdoms, we have a fine orographical map showing by difference of tint both the varying height of the land and the varying depths of the sea around our shores; and another map showing the distribution of the rainfall. There is a separate map of Japan, a very useful one of the Indian Archipelago, and a map of Africa in which several of the hitherto vaguely indicated Central States have had an approximate definition given to their areas. These are a few of the more prominent features of the atlas. The execution is on the whole thoroughly satisfactory; several of the maps, indeed, were originally by Arrowsmith. Appended is a copious index of places, with their latitude and longitude.